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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/790,759

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Eiji Maruyama

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EXAMINER

MOWLA, GOLAM

ART UNIT

PAPER NUMBER

1795

MAIL DATE

DELIVERY MODE

08/12/2008

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/790,759	<b>Applicant(s)</b> MARUYAMA, EIJI	
	<b>Examiner</b> GOLAM MOWLA	<b>Art Unit</b> 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 26 June 2008.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 8-11, 14, 19 and 20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 8-11, 14, 19 and 20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment of 06/26/2008 does not render the case allowable.
2. Claims 8-11, 14, and 19-20 are currently pending. Applicant has amended claims 8 and 19, cancelled claims 1-7, 12-13 and 15-18.

### ***Status of the Rejections***

3. Due to Applicant's amendment of claims 8 and 19, all rejections from the office Action mailed on 03/28/2008 are withdrawn. New ground(s) of rejection under 35 U.S.C. 103 is/are necessitated by the amendments.

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.

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4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
6. Claims 8-11, 14, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admitted prior art in view of Vink et al. ("On the homogeneity of sputter-deposited ITO films ...microstructure" - Thin Solid Films 266 (1995) pp145-151) and Adurodija et al. ("Effect of Sn doping on the electronic transport mechanism of indium-tin-oxide films grown by pulsed laser deposition coupled with substrate irradiation" - J. Appl. Phys. 88 (2000) pp 4175-4180). Supporting evidence is provided by Neerinck et al. ("Depth profiling of thin ITO films by grazing incidence X-ray diffraction" - Thin Solid Films 278 (1996) pp12-17),

Regarding claims 8, 14 and 19, Applicant's admitted prior art discloses (See Background of the invention; pages 2, lines 1-19; see also fig. 7) a photovoltaic device (fig. 7; page 2, lines 1-19) comprising:

- a first conductivity type or n-type single-crystalline silicon semiconductor substrate (n-type single-crystalline silicon substrate 101; fig. 7; page 2, lines 1-19) having a front surface (top surface on which i-type amorphous silicon layer 102 is disposed) and a back surface (surface on which back electrode 106 is disposed; see fig. 7) and receiving light incident from the side of said front surface;
- a substantially intrinsic first amorphous silicon semiconductor layer (i-type amorphous silicon layer 102; fig. 7; page 2, lines 1-19) formed on said front surface (top surface; see fig. 7) of said single-crystalline silicon

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- semiconductor substrate (101), the substantially intrinsic first amorphous silicon semiconductor layer (102) consisting of a single layer (see fig. 7);
- a second conductivity type or p-type second amorphous silicon semiconductor layer (a p-type amorphous silicon layer 103; fig. 7; page 2, lines 1-19) formed on said first amorphous silicon semiconductor layer (102); and
  - a transparent conductive film (transparent conducting film 104; fig. 7; page 2, lines 1-19) consisting of indium-tin-oxide (ITO; page 2, lines 5-6), formed on said second amorphous silicon semiconductor layer (103)
    - wherein a collector (collector 105; fig. 7; page 2, lines 9-13) is formed on the transparent conductive film (104).

However, the admitted prior art is silent as to whether the indium oxide layer having (222) plane orientation with two (222) peaks in said indium oxide layer, wherein said indium oxide layer contains Sn, and the content of Sn with respect to In in said indium oxide layer is at least about 2 percent by weight and not more than about 7 percent by weight.

Vink discloses an indium tin oxide film suitable for use in optoelectronic applications as a transparent conductor (Introduction, 1st paragraph). The x-ray diffraction pattern of one such film, i.e., a film that is annealed and sputter-deposited at room temperature according to the teachings of Vink et al., appears in Figure 1 of Neerincx et al. As shown in Figure 1, this film has a (222) plane orientation with two (222) peaks ("doublet-type peak profile," figure caption) in its x-ray diffraction spectrum.

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Further, Vink et al. report results showing that annealed, tin oxide films sputter deposited at room temperature on tin oxide films have low intrinsic stress (Conclusion paragraph, 2<sup>nd</sup> to last sentence). Vink et al. further disclose that the use of indium tin oxide films with low internal stress is advantageous to prevent deformation and fracture (Introduction, 1<sup>st</sup> paragraph).

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the ITO film of Vink in the photovoltaic device of the admitted prior art in order to prevent deformation and fracture.

However, the modified device of admitted prior art lacks the content of Sn in the indium tin oxide layer with respect to In is at least about 2 percent by weight and not more than about 7 percent by weight.

Adurodija teaches a series of composition for ITO films that may be used in "many optoelectronic applications, including flat panel displays and solar cells" (Introduction, first paragraph). Adurodija shows in Figure 4a that the carrier concentration of these films increases with weight % of Sn from 0-6 wt. % and then either decreases or levels off from 6-10 wt. % Sn. Thus, Adurodija et al. show in this figure that the maximum carrier concentration for these films occurs around 6 wt. % Sn. Adurodija et al. disclose in first paragraph of the introduction that high carrier concentration and low resistivity are optimal for use in solar cell applications as transparent conductors.

It would have been obvious to one of ordinary skill in the art at the time of the invention to choose a composition of the tin oxide layer used as the transparent

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conductive layer in the device of the admitted prior art that is around 6 wt. % Sn as instructed by Adurodija in order to optimize the carrier concentration of the film.

As to claims 9 and 20, said (222) peaks in Figure 1 of Neerinck et al. include: a first peak having an X-ray diffraction angle,  $2\theta$ , of about  $30.1 \pm 0.1$  degrees, and a second peak having an X-ray diffraction angle,  $2\theta$ , of about  $30.6 \pm 0.1$  degrees.

As to claim 10, the ratio (11/12) of the intensity of said first peak (11 = 2.5, in arbitrary units, according to Figure 1 of Neerinck et al. ) to the intensity of said second peak (12 = 5.5, in arbitrary units, according to Figure 1) is approximately 0.46.

As to claim 11, the ratio (11/12) of the intensity of said first peak (11 = 2.5, in arbitrary units, according to Figure 1 of Neerinck et al.) to the intensity of said second peak (12 = 5.5, in arbitrary units, according to Figure 1) is approximately 0.46.

### ***Response to Arguments***

7. Applicant's arguments with respect to claims 8-11, 14 and 19-20 have been considered but are moot in view of the new ground(s) of rejection.

Due to Applicant's amendment to claims 8 and 19, a new ground(s) of rejections is made in view of Applicant's admitted prior art, Vink et al. (as presented in the previous office action) and Adurodija et al. (as presented in the previous office action).

*Claim Rejections under 35 U.S.C. § 103 (a)*

Claims 8 and 9

Applicant argues that “amended claims 8 and 19, inter alia, recite “a substantially intrinsic first amorphous silicon layer formed on said front surface of said single-crystalline silicon substrate, the substantially intrinsic first amorphous silicon layer consisting of a single layer.” As disclosed in FIG. 1, one example of what is recited in claims 8 and 19, the substantially intrinsic i-type amorphous silicon layer 2 formed on the upper surface of the n-type single-crystalline silicon substrate 1 consists of a single layer” (see Remarks, page 6).

Applicant also argues that “the proposed combination of Nakamura, Vink and Adurodija fails to disclose the limitations of claims 8 and 19” (see Remarks, page 6).

Applicant also argues that “Nakamura's intrinsic amorphous silicon carbide layer 13 and p-type amorphous silicon film 14, on which the Examiner relied to disclose the “substantially intrinsic first amorphous silicon layer,” is composed of two layers, intrinsic amorphous silicon carbide layer 13 and p-type amorphous silicon film 14. In contrast, claims 8 and 19 require the “the substantially intrinsic first amorphous silicon layer” to “consisting of a single layer” (see Remarks, page 6).

The argument is persuasive. However, due to Applicant’s amendment to claims 8 and 19, a new ground(s) of rejection is made in view of Applicant's admitted prior art, Vink et al. (as presented in the previous office action) and Adurodija et al. (as presented in the previous office action).

***Conclusion***

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

***Correspondence/Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GOLAM MOWLA whose telephone number is (571) 270-5268. The examiner can normally be reached on M-F, 0900-1700 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ALEXA NECKEL can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./  
Examiner, Art Unit 1795

/Alexa D. Neckel/  
Supervisory Patent Examiner, Art Unit 1795